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ABSTRACT

This manual was developed to guide machine trades instructors and vocational supervisors in sequencing laboratory instruction and controlling the flow of work for a 2-year machine trades training program. The first part of the guide provides information on program management (program description, safety concerns, academic issues, implementation strategies, and evaluation strategies), lifetime skills, entrepreneurship skills, a list of items needed for student tool kits, shop tools and major equipment lists, and a competency list for machine trades. Following sections contain information on organization of the 2 years of the program, rotation charts for the four 9-week periods in each year, and outlines of 13 units for junior year and 11 units for senior year. Each unit includes time allotted, lab status, number of new competencies, instructional objective, list of competencies, and suggested management and evaluation strategies. The junior year units cover the following topics: orientation, shop management, and safety; measuring tools; bench work; layout; power saws; abrasives; shapers; developing and reinforcing competencies; lathes; drill presses; mills; computer-aided manufacturing, numerical control, and robotics (basic); and developing and reinforcing competencies. Senior units cover orientation, shop management, and safety; measuring tools and layout; abrasives (review); superabrasives; heat treating and metallurgy; lathes; developing and reinforcing competencies; drill presses; mills; computer-aided manufacturing, numerical control, and robotics (intermediate); and developing and reinforcing competencies. An appendix provides a progress chart for recording student competencies. (KC)

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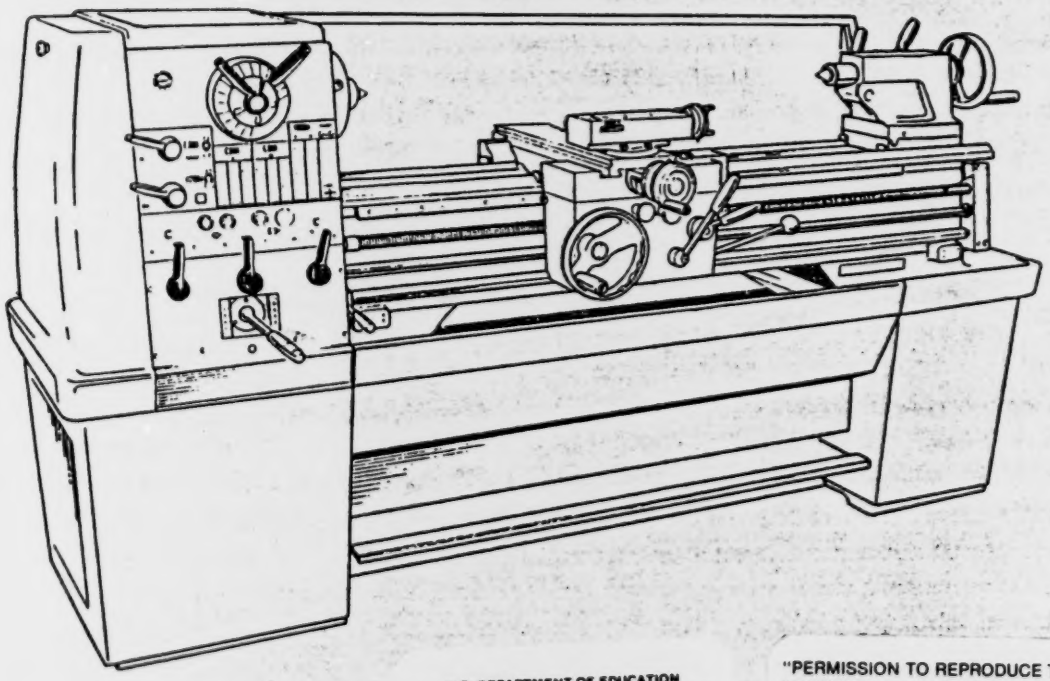

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MACHINE TRADES LAB MANAGEMENT GUIDE

Vocational Instructional Materials Laboratory
The Ohio State University
Columbus, Ohio

1991

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FOREWORD

The purpose of this manual is to guide machine trades instructors and vocational supervisors in sequencing manipulative instruction and controlling the flow of live work for a two-year machine trades training program.

This document is intended to serve as a reference for organizing lab activities; it is not a course of study or a full curriculum guide.

A few abbreviations common to the machine trades are used throughout this document. These abbreviations and their meanings are as follows:

CAM - Computer-aided manufacturing
CNC - Computer numerically controlled
CBN - Cubic boron nitride
ID - Inside diameter
OD - Outside diameter
PCD - Polycrystalline diamond
SNG - Square negative ground
SPG - Square positive ground

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PROGRAM MANAGEMENT

Program Description

1. The ***Machine Trades Lab Management Guide*** is designed for conducting a three-hour lab period. Additional related technical information is also to be presented.

2. The machine trades lab management program is designed to be flexible. This enables machine trade instructors and program supervisors to alter the program's sequence and the time schedule in order to meet the individual needs of the school, the community, and the industry.

3. This specific program is organized to teach the competencies required in an entry-level machine trades job.

Safety Concerns

1. The instructor(s) must teach safety daily and demand strict adherence to all safety regulations at all times. The instructor(s), all students, and all visitors must wear safety glasses and ear plugs whenever such devices are called for in the lab or at field sites.

2. It is essential that each instructor document instruction given to individual students on safety, develop a safe-practices evaluation, and file the documents for future reference.

3. Machine trades instructor(s) should dispose of hazardous waste in accordance with federal and state guidelines.

Academic Issues

1. Duly certified teachers must provide instruction in applied mathematics, science, and communication skills. Academic credit will be assigned through Program Options or through "Principles of Technology."

2. All students must have access to computer training must.

3. Lifetime skills should be taught in all phases of the program and practiced throughout the entire junior and senior years of the program. Lifetime skills are defined as nontechnical competencies necessary to operate successfully in the business world. A progress chart should be posted and continually updated to encourage the development of lifetime skills.

4. The instructor(s) should consider incorporating learning activities that demonstrate entrepreneurship concepts. These business-related concepts may be discussed in the related classroom lessons.

5. Local technical and community colleges should be contacted to ascertain the feasibility of establishing articulation agreements whereby machine trades graduates may enter postsecondary degree programs with advanced standing. Likewise, similar articulation arrangements should be explored with local apprenticeship programs.

6. Class participation in the student organization Vocational Industrial Clubs of America (VICA) and in its sponsored competition and leadership activities is necessary and should be supported and encouraged by the instructor(s), the program supervisor, and the school administrators.

7. The machine trades instructor(s) must organize a craft advisory committee and meet with the committee regularly throughout the school year. Advisory committee members can also serve as guest speakers, competition judges, a source of equipment and supplies, hosts for field trips, future employers of students, and advisors regarding program policies and curriculum review.

8. The standard reference for definition of terminology and other fundamental data for this lab management guide is the most recent edition of the **Machinists' Ready Reference** compiled by C. Weingartner and published by Prakken Publications in Ann Arbor, Michigan.

9. The instructor(s) should regularly attend professional and technical conferences and seminars to keep abreast of current trade technology and educational trends.

Implementation Strategies

1. At the beginning of each instructional group the instructor(s) must provide appropriate demonstrations with regard to skill level and required safety in order that students may begin practicing on competencies as soon as possible.

2. The instructor(s) should select appropriate competencies from the course outline to fit students' special needs, and should include these competencies in the Individualized Educational Plan (IEP) for each student requiring individualized instruction and consideration.

3. The instructor(s) should require students to understand and practice shop management competencies throughout the two-year program.

4. Student competency charts must be kept up to date during this sequenced program.

5. All competencies listed for the program should be demonstrated by the instructor(s) and practiced by all students during the two-year program; however, some advanced competencies may be so difficult that not all students will be able to perform them. It is recommended that, at a minimum, a thorough demonstration of the advanced or complex competencies be presented to all students in the program.

6. Students who master basic competencies in less than the allotted time frame may be exposed to intermediate competencies through demonstration and application. Advanced competencies should be taught in a separate course, in a postsecondary program, or in an apprenticeship program.

7. Students who proceed at a pace faster than average may assist slower students.

8. The equipment, tools, and supplies suggested in this lab management guide are minimal and should by no means be considered to be complete. It is recommended that more equipment be added as needed based upon local needs and advisory committee input and assistance.

9. The instructor(s) should design and administer rotation schedules to route all students through the competencies within the given time periods.

10. No more than two students should be assigned to each work station.

11. Lab competencies should be planned and performed in a manner that simulates actual working conditions whenever possible.

12. The machine trades curriculum should include the teaching of troubleshooting techniques.

13. A materials management program should be implemented to maximize materials usage, minimize materials waste, and provide adequate materials storage.

14. If an early placement program is used, the instructor(s), students, administrators, and cooperative employers must ascertain in advance which labor laws apply to a given cooperative job station. Moreover, a specific training plan must be provided for each student who is placed in a

cooperative job station.

15. Away-from-school activities should be undertaken only when proper transportation, liability insurance, and first aid procedures have been provided. The instructor(s) should take along copies of relevant student medical forms to off-grounds activities.

16. If the local school district opts to contract for outside work to be done in the machine trades lab, the work should be done by senior-year students. The instructor(s) and the administration always need to take into consideration the instructional relevance of any outside work.

17. Awards in the form of patches or emblems should be offered to all students completing instructional groups of the machine trades program.

Evaluation Strategies

1. Students should demonstrate machine trades competencies to meet the accepted standards of the industry.

2. A series of lab evaluations should be conducted each week to determine eligibility for advancement or the necessity for additional instruction and practice.

3. After a competency is demonstrated satisfactorily by students, the instructor(s) should continue to monitor the performance and refinement of that competency throughout, the remainder of the two-year program.

4. A comprehensive competency profile that itemizes demonstrated machine trades skills should be issued to each student who completes the two-year machine trades program.

LIFETIME SKILLS

The student will learn to do the following:

1. Work effectively under different kinds of supervision.
2. Work without the need for close supervision.
3. Be on time for activities and appointments.
4. Work effectively when time and pressure are critical factors for success.
5. Be responsible for the effects of his or her own judgment and actions.
6. Plan, conduct, and complete activities on his or her own initiative.
7. Work cooperatively as a team member.
8. Work effectively with people of different personalities.
9. Coordinate his or her activities with others.
10. Instruct or direct another in the performance of a specific competency.
11. Demonstrate how to perform a specific competency.
12. Assign others to carry out specific competencies.
13. Identify the existence of a problem, given a specific set of facts.
14. Ask appropriate questions to identify or verify the existence of a problem.
15. List the possible causes of a problem.
16. Identify important information needed to solve a problem.
17. Generate possible alternative solutions to a problem.
18. Describe the application and likely consequences of alternative solutions.

Source: Adapted from F.C. Pratzner and J.F. Russell, The Changing Workplace: Implications for Quality of Work Life Developments for Vocational Education (Columbus, Ohio: National Center for Research in Vocational Education, 1984), pp. 55-57.

19. Estimate the potential likelihood of some event's occurrence and probable sequence.

20. Use appropriate processes in order to make a decision.

21. Set priorities in which several competencies could be accomplished.

22. Determine the step-by-step process by which a specific competency may be accomplished.

23. Estimate the time required to accomplish a specific competency.

24. Select materials and resources needed to perform a specific competency.

25. Gather information or data from books, manuals, and other printed documents.

26. Speak fluently and effectively with both individuals and groups.

27. Listen carefully and take accurate notes from spoken communication.

28. Use previously learned knowledge and skills in a new situation.

29. Learn to recall ideas, facts, and information accurately.

30. Learn to state clearly and defend a position.

31. Learn to estimate profit.

32. Learn to make cost-saving suggestions.

33. Learn to understand such concepts as power, control, authority, and delegation.

34. Learn defining specifications, defects, tolerances, control limits, inspection, and quality control.

ENTREPRENEURSHIP SKILLS

1. Understanding the Nature of Small Business

   a. Define the role of small business in the U.S. economy.
   b. Analyze factors that contribute to small business success.

2. Determining Your Potential as an Entrepreneur

   a. Identify the personal characteristics of entrepreneurs.
   b. Evaluate your potential for starting a business.

3. Developing the Business Plan

   a. Describe the contents of a business plan.
   b. Recognize the importance of a well-designed business plan.

4. Obtaining Technical Assistance

   a. Recognize the importance of obtaining technical assistance.
   b. Determine the type of technical assistance needed by a new business.

5. Choosing the Type of Ownership

   a. Describe advantages and disadvantages of business ownership types.
   b. Analyze factors influencing the choice of ownership type.

6. Planning the Market Strategy

   a. Explain the importance of marketing activities for business success.
   b. DEfine the components and purpose of a marketing plan.

7. Locating the Business

   a. Examine the factors for selecting a good business site.
   b. Outline the steps for selecting the correct business site.

Source: Ashmore, K., and S. Fritz. Program for Acquiring Competence in Entrepreneurship (PACE). Columbus, Ohio: National Center for Research in Vocational Education, 1983.

8. Financing the Business

   A. Recognize factors to consider in obtaining finances for a new business.
   b. Determine information needed to obtain financing from different sources.

9. Dealing with the Legal Issues

   a. Explain uses of contracts in small business.
   b. Define legal issues encountered by entrepreneurs.

10. Complying with Government Regulations

   a. Explain how the different types of legislation affect and protect small business.
   b. Determine government regulations, licenses, and permits affecting small business start-up.

11. Managing the Business

   a. Recognize the importance of sound management techniques to business success.
   b. Identify specific management techniques used by entrepreneurs.

12. Managing Human Resources

   a. Explain the responsibilities involved in managing human resources.
   b. Identify techniques that may be used to manage human resources.

13. Promoting the Business

   a. Describe methods of promotion used by small business.
   b. Analyze techniques and cost factors in small business promotional planning.

14. Managing Sales Efforts

   a. Outline what successful salespeople in a small business need to know.
   b. Analyze selling strategies appropriate to the type of business.

15. Keeping the Business Records

   a. Describe the components of a sound record-keeping system.
   b. Identify the type of financial data obtained from business records.

16. Managing the Finances

    a. Identify the various financial statements and ratios used by businesses to manage finances.
    b. Describe the components and construction of various financial statements.

17. Managing Customer Credit and Collection

    a. Explain factors to consider in small business credit and collections.
    b. Describe the management of customer credit and collections.

18. Protecting the Business

    a. Identify the types of risks faced by entrepreneurs.
    b. Describe precautions to take against threats to the business.

SUGGESTED STUDENT TOOL KIT FOR THE MACHINE TRADES LAB

The following list of tools is a suggested student starter tool kit. Local conditions may warrant alterations to the list. As this is a starter tool kit, not a journeyperson's tool kit, the students will probably add to the kit in future years. The student may machine some of the items on the following list at the instructor's discretion.

ITEM	QUANTITY
Brush, paint, 2", camel hair	1
Caliper, toolmaker's, hermaphrodite, 6"	1
Caliper, toolmaker's, inside 6"	1
Caliper, toolmaker's, outside 6"	1
Center punch	1 set
Cold chisel	1 set
Depth Gage, combination hook rule and gage, 6"	1
Dividers, toolmaker's, 6"	1
Gage, center	1
Gage, drill point	1
Gage, screw pitch	1 set
Gage, radius/fillet	1 set
Gage, thickness	1 set
Hammers, ball peen, 4 oz and 16 oz	1 each
Machinists' Ready Reference handbook	1
Micrometer, outside, 0-1" through 10 thousandths	1
Micrometer, outside, 1" - 2" through 10 thousandths	1
Pliers, locking grips, 8"	1
Pliers, slip joint, 6"	1
Prick punch	1 set
Protractor, steel 6"	1
Rule, steel, 6"	1
Safety goggles or sideshield glasses, type Z-87	1
Screwdriver, blade	1 set
Screwdriver, phillips	1 set
Scriber, pocket	1
Soft-face hammer	1
Square, combination square and center head	1
Stone, sharpening, small Arkansas	1
Tape, steel, measuring, 8'	1
Tool box, key locking type, 8 1/2" x 13 3/4", with drawers	1
Universal indicator set	1
Vernier calipers, 6"	1
Wrench, adjustable, 10"	1
Wrench, hexagonal key, Allen type, metric, 1.5 mm through 10 mm	1 set
Wrench, hexagonal key, Allen type, 1/16" through 3/8"	1 set

SUGGESTED SHOP TOOLS FOR THE MACHINE TRADES LAB

The following tools are suggested to serve 25 students in a vocational machine trades program. These are laboratory tools and are not a substitute or replacement for tools listed in the student starter tool kit.

ITEM	QUANTITY
Hand Tools	
Calipers, hermaphrodite, firm joint, 6"	2
Calipers, micrometer, screw thread, 0 to 1", 14-20 threads per inch	1
Calipers, toolmaker's spring-type, inside, 3"	4
Calipers, toolmaker's spring-type, inside, 6"	2
Calipers, toolmaker's spring-type, outside, 3"	4
Calipers, toolmaker's spring-type, outside, 6"	2
Chisel, cape, 5/32" cut	4
Chisels, cold, 3/8", 1/2", 3/4", and 1" cut	4 each
Chisel, diamond, 5/32" cut	4
Comparator, microfinish	4
Dial indicator, holder, magnetic base, and attachments	6
Dial indicator, "Last Word" test type, .0005 graduations	2
Dial indicator, 1" travel, .0005 graduations	6
Dividers, toolmaker's spring type, 3"	4
Dividers, toolmaker's spring type, 6"	2
Drill, drift, numbers 1, 2, 3, and 4	4 each
Edge finder, 3/8" and 1/2" sizes	4
File cards	1 dozen
File, double-cut mill bastard, 8"	2 dozen
File, half-round bastard, 8"	2 dozen
File handles, numbers 1, 2, 3, and 4	1 dozen each
File, round, 8"	2 dozen
File, single-cut mill bastard, 8"	4 dozen
File, single-cut mill bastard, 10"	2 dozen
File, slim-taper triangular, 6"	2 dozen
File, square, 8"	2 dozen
File, Swiss-pattern	2 sets
Gage, acme screw thread, 29 degrees, 1 to 10 threads per inch	2
Gage blocks, 81-block set, accuracy + .000004", - .000002", range to 12", chrome carbide, etched serial numbers with certificate of inspection and accessories	1 set
Gage, center, U.S. 60 degrees standard	12
Gage, drill, fractional sizes 1/16" to 1/2" by 1/64" graduations	4
Gage, drill, letter sizes A-Z	3
Gage, drill, number sizes 1-60	3

Measuring and Layout Tools

Gage, drill point, with 6" hook-point rule, sliding head, and 59 degrees bevel	12
Gage, planer and shaper, 1/4" to 9" extension	1
Gage, radius/fillet, 1/32" to 1/2" x 1/64" graduations	2 sets
Gage, screw and wire, American standard	2
Gage, screw pitch metric	2
Gage, screw pitch, 60 degrees, 4 to 84 threads per inch	2
Gage, small-hole, flatted contacts, .125" through .500"	2 sets
Gage, surface, universal with accessories	4
Gage, telescoping, 5/16" to 6"	2 sets
Gage, thickness, tapered leaves, .004" to .025" by thousandths	3 sets
Hacksaw blades, 10, 14, 18, 24, and 32 pitch	2 dozen each
Hacksaw frame, hand, 2 7/8" x 12"	6
Hammer, ball-peen, 8 oz	4
Hammer, ball-peen, 16 oz	2
Hammer, ball-peen, 24 oz	1
Hammer, hand sledge, 2 1/2 lb	1
Hammer, rubber (or equivalent), 2" diameter head	4
Height gage, vernier 18"	1
Magnifier, four-lens	2
Magnifying glass, 3X to 7X power	2
Mallets, dead-blow (preferably neoprene)	3 each
Measuring tape, steel, 20' x 3/4"	1
Metric micrometer, 0 to 25mm	1
Metric micrometer, 25 to 50mm	1
Micrometer, 0-1" outside, graduated in 10 thousandths of an inch	2
Micrometer, 1"-2" outside, graduated in 10 thousandths of an inch	4
Micrometer, 2"-3" outside, graduated in 10 thousandths of an inch	4
Micrometer, 3"-4" outside, graduated in 10 thousandths of an inch	2
Micrometer, 4"-5" outside, graduated in 10 thousandths of an inch	2
Micrometer, 5"-6" outside, graduated in 10 thousandths of an inch	2
Micrometer, 6"-12" inside, interchangeable rod type, graduated in thousandths of an inch	1 set
Micrometer, 12" to 24", graduated in thousandths of an inch/interchangeable rod	1 set
Micrometer depth gage, 0-6", interchangeable rod type, graduated in thousandths of an inch	2 sets

Measuring and Layout Tools

Parallels, adjustable, 5" x 3/8" to 2 1/4"	2 sets
Parallel clamps, toolmaker's, 1 3/4" capacity, 2 1/2" jaws	2 pair
Parallel clamps, toolmaker's, 3 1/3" capacity, 5" jaws	2 pair
Parallels, steel, 1/4" x 1/2" through 3/4" x 1"	2 sets
Pliers, diagonal, 6"	1
Pliers, duckbill, 8"	1
Pliers, needle nose, 6"	1
Pliers, locking-grip, 3", 6", and 10"	2 each
Pliers, slip-joint, 8"	2
Protractor and depth gage, steel satin chrome with rectangular head, 6"	4
Protractor, universal bevel, 4R graduation, 12"	1
Punch, drive pin, 4" x 1/16" through 4" x 5/16"	1 set
Punch set, center	3 sets
Rule, spring steel, satin-finish stainless steel with 4R graduations, 6"	6
Rule, spring steel, satin-finish stainless steel with 4R graduations, 12"	2
Rule, spring steel, satin-finish stainless steel with 4R graduations, 24"	1
Screwdriver, blade, assorted sizes	2 sets
Screwdriver, Phillips, assorted sizes	2 sets
Square combination with square, center, and reversible protractor heads, satin-finish blade, 12"	6
Square combination, square head only, satin-finish blade, 6"	3
Square, hardened steel, 3" blade	2
Square, hardened steel, 6" blade	2
Stamps, steel, number and letter, 3/16"	1 set
Straightedge, steel, 18" beveled, one edge graduated in 32nds of an inch	2
Straightedge, steel, 36" beveled, one edge graduated in 32nds of an inch	1
Surface plate, granite, pink or black, 4" x 18" x 24"	2
Trammels beam, 10", 14", 20", and 24"	1 each
Trammels, including two sizes divider points, two sizes legs, four ball points, and holder	1 set
V block and clamp, 2" round capacity, matched pairs	4 pair
Vise, precision, 6"	1
Wiggler	2
Wrench, adjustable, 8"	4
Wrench, adjustable, 10"	4
Wrench, adjustable, 15"	1
Wrench, combination, 3/8" to 15/16"	1 set

Measuring and Layout Tools

Wrench, combination metric, 5mm through 19mm	1	set
Wrench, hexagonal-key Allen, 1/16" through 9/16"	4	sets
Wrench, hexagonal-key Allen, metric, 1.5mm through 14.5mm	1	set
Wrench, pipe, straight-handle, 8" and 14"	1	each

Equipment and Machining Accessories

Broaches, common sizes, types, and shapes		
Buffing and polishing wheels, common cloths, weaves, classes, and sizes		
C-Clamps, steel, 2" opening	4	
C-Clamps, steel, 4" opening	4	
C-Clamps, steel, 6" opening	4	
C-Clamps, steel, 8" opening	4	
Carbide inserts, SNG 432 or 442	10	
Dies, common sizes and types		
Dogs, lathe, capacity 3/8" through 2"	2	each
Dresser, Carboloid stick	12	
Dresser, grinding wheel, abrasive-wheel type	2	
Dresser, grinding wheel, diamond, magazine-type	2	
Dresser, grinding wheel, Huntington-type	2	
Dressing sticks, aluminum oxide	10	
Drill index, straight shank, fractional 1/16" to 1/2" in 64ths	4	sets
Drill index, straight shank, letters A through Z	3	sets
Drill index, straight shank, numbers 1 through 80	3	sets
Extractor, screw	4	
Extractor, tap, number 4' through 1"	2	
Grinding wheel, D 11 V 9 tool and cutter, resin-bonded CBN	1	
Grinding wheel, D 11 V 9 tool and cutter, resin-bonded diamond	1	
Grinding wheels, bench and pedestal, common sizes, grits and grades		
Grinding wheels, hand grinder, common shapes, sizes, shafts, grits, and grades		
Grinding wheels, tool and cutter, common sizes, shapes, grits, and grades		
Hold downs, steel, 6"	2	sets
Insert holder	1	
Milling cutters, horizontal, common sizes, shapes, types, and materials		
Milling cutters, vertical, common sizes, shapes, shanks, types, flutes, styles, and materials		
Polycrystalline CBN insert, SNG 432, 433, or 434	1	
Polycrystalline diamond insert, SPG 432, 433, or 434	1	
Precision machinist's vise, C jaw, 4 1/2" opening	10	
Replacement wheel for brake-controlled trueing device	1	
Rotary files, common shapes, shanks, styles and type		

Tools bits, common sizes, types and grades	
Trueing device, brake-controlled	1
Trueing nib, diamond	1
Vise, drill press, all angles, 2 1/2" jaws, 4" opening	1
Vise, drill press C jaw, C opening	1

Equipment and Machining Accessories (continued)

Vise, drill press, 2 1/2" jaws, 4" opening	1
Vise, machine, common sizes and types for setup on machines	
Wrench, tap, T-handle, 1/4" through 1/2"	2
Wrench, tap, T-handle, numbers 0 through 10 capacity	2
Wrench, tap, straight-handle, 1/4" to 1/2" capacity	2

NOTE: The quantities of the following items needed depend on the equipment available in the laboratory and the type of projects or jobs to be performed. Each instructor must review the requirements and determine the quantities necessary.

Drills, common sizes, shanks, Morse tapers, 5/8"	
Reamers, common sizes, shanks, Morse taper, 5/8"	
Reamer, index, straight-shank, .001 under, size, .001 over, 1/8" through 1/2"	
Taps, common sizes, shanks, types, and flutes	

Miscellaneous Lab Tools and Equipment

Air blowgun, standard fittings with extension nozzle	2
Air hose, 3/8" inside diameter, with fittings, 30' length	2
Air pressure regulator, 0 to 140 pounds working pressure, with pressure gauge	1
Broom, bench, Tampica fiber, 2 1/2" trim, 8" brush length	12
Broom, floor, mixed block hair, 3 1/4" trim, 18" with handle	6
Brush, bench, 8"	6
Cabinet for safety glasses, metal, with ultraviolet germicidal lamp	1
Drill motor, hand, electric, 110 volt, 1/2" capacity, variable speed	1
Drill motor, hand, electric, 110 volt, 3/8" capacity, variable speed	1
Engraving tool, electric vibrating, 110 volt	1
Extension cord, electrical, 3-wire, 12-3 size, 25' length	2
Extension cord, electrical, 3-wire, 12-3 size, 50' length	1
First-aid kit and supplies	1

Miscellaneous Lab Tools and Equipment (continued)

Funnel, galvanized, sizes 1 pt, 1 qt, 1 gal	1	each
Grease gun, hand, 16 oz capacity, heavy-duty	2	
Hand grinder, 1/4" chuck, 20,000 rpm, 1/10 hp	2	
Oiler, pump, heavy-duty handled, 1 pt, flexible spout	3	
Oiler, pump, heavy-duty handled, 1 pt, rigid spout	2	
Oiler, bench, heavy-duty 1/2 pt, 6" rigid spout	4	
Oil stone, reversible, coarse and fine grit, 7" x 2" x 5/8" in box	4	
Safety can, 3 gal capacity, flexible spout	2	
Safety can, 5 gal capacity, flexible spout	2	
Safety glasses for visitors, sideshield, type Z-87	12	
Snips, tinner's, 1 3/8" cut, left-cutting	2	
Snips, tinner's, 1 3/8" cut, right-cutting	2	
Snips, tinner's, 1 3/8" cut, straight-cutting	2	
Soldering iron, 90 watts, 110 volt, 1/2" screw tip with stand	1	
Squeegee, floor, straight 24" blade, with handle and rubber replacement blades	3	
Stock cart, steel, 30" long, 16" wide, 32" high, two shelves, 5" diameter wheels, 2 swivel and 2 stationary	4	
Stools, shop, 26", steel angle-welded legs, metal seats, without backs	1	
Tongs, single pick-up, 24" length	2	
Waste can, oily, 10-gal capacity	3	
Welding apron, leather	3	
Welding goggles, wide-vision type for furnace operations	3	
Welding gloves, gauntlet	3	pairs

Consumable Materials

The quantities, types, and quality of materials needed depend on the program, equipment, and types of jobs to be performed. Review the requirements and determine the quantities necessary. Local conditions may require additions to or modifications of the following list.

Abrasive cloth
Abrasive paper
Band and hacksaw blades
Bolts, nuts, screws, pins, and washers
Buffing compounds
Cleaning rags
Cleaning solutions
Cutting fluids
Heat-treating mediums
Lapping compounds
Layout dyes, solutions, and materials
Lubricants

Metal stock
Solder and flux
Temperature indicators (pellets, crayons, paints)

SUGGESTED MAJOR EQUIPMENT FOR THE MACHINE TRADES LAB

The following equipment is recommended for a vocational machine trades program with 25 students.

ITEM	QUANTITY
Air compressor, vertical, 5 hp, with humidity bulb and pressure gauge, and all connecting accessories	1
Bench grinder	2
Bench, welding, 1/2" x 30" x 36" x 72"	1
CAM station	2
Carbide tool grinder, and accessories	1
CNC lathe (training model)	4
CNC Mill, (training models)	4
Cylindrical grinder, and accessories	1
Engine lathe, various sizes, and accessories	10
Hand surface grinder, and accessories	2
Heat treating furnace, and pyrometer and metal handling tongs	1
Heavy materials handling equipment, one-ton hoist with trolley or tow motor	1
Horizontal milling machine, and accessories	2
Horizontal power cut-off saw (band), and accessories	1
Hydraulic arbor press	1
Hydraulic surface grinder, and accessories	1
Layout table, granite, 4" x 18" x 24"	2
Machine accessory benches, 30" x 36" x 72"	15
Metal cutting band saw, and accessories	1
Metal storage racks, 5 shelf style, 18" x 4' x 6'	5
Optical comparator	1
Oxyacetlylene tanks with welding and cutting accessories	1
Pedestal drill, and accessories	2
Pedestal grinder	2
Radial drill press, and accessories	1
Robotic arm (training model)	1
Rockwell hardness tester, B and C scales and accessories	1
Shaper, and accessories	1
Small arbor press, mechanical	1
Storage rack (lock type) for fifty student tool kits	1
Surface plate and cover, cast iron, 3/4" x 24" x 48"	1
Tool and cutter grinder, and accessories	1
Turret lathe, and accessories	1
Vertical milling machine, and accessories	5
Vise, bench, swivel, 6" jaws	12

UNITS OF INSTRUCTION FOR MACHINE TRADES

UNIT A. Orientation, Shop Management, and Safety

UNIT B. Measuring Tools

UNIT C. Benchwork

UNIT D. Layout

UNIT E. Power Saws

UNIT F. Abrasives

UNIT G. Superabrasives

UNIT H. Shapers

UNIT I. Lathes

UNIT J. Drill Presses

UNIT K. Mills

UNIT L. CAM, CNC, and Robotics Equipment

UNIT M. Heat Treating and Metallurgy

COMPETENCY LIST FOR MACHINE TRADES

UNIT A. Orientation, Shop Management, and Safety

A- 1. Take shop safety and safety test.
A- 2. Explain emergency safety procedures.
A- 3. Explain lab rules.
A- 4. Review grading procedures.
A- 5. Receive safety glasses.
A- 6. Explain tool crib duties and receive tool checks.
A- 7. Describe lab maintenance schedule.
A- 8. Describe lab cleanup duties.
A- 9. List general lab supervisor's duties.
A-10. List lab safety supervisor's duties.

UNIT B. Measuring Tools

B- 1. Use steel rules.
B- 2. Use a tape measure.
B- 3. Use calipers (ID, OD, and hermaphrodites).
B- 4. Use dividers.
B- 5. Use a combination square set.
B- 6. Use a pitch gage.
B- 7. Use a center gage.
B- 8. Use a drill point gage.
B- 9. Use depth gage.
B-10. Use a tool gage.
B-11. Use an Acme thread gage.
B-12. Use a protractor and depth gage.
B-13. Use a Go/No Go gage.
B-14. Use a snap gage.
B-15. Use a surface gage.
B-16. Use a feeler gage.
B-17. Use a combination depth and angle gage.
B-18. Use a plug and ring gage.
B-19. Use a taper hole gage.
B-20. Use a hole gage.
B-21. Use a telescoping gage.
B-22. Use an inside micrometer.
B-23. Use an outside micrometer.
B-24. Use vernier calipers.
B-25. Use a depth micrometer.
B-26. Use a cylindrical square.
B-27. Use thread wire.
B-28. Use Jo blocks.
B-29. Use a sine bar.
B-30. Use a universal bevel protractor.
B-31. Use a dial caliper.
B-32. Use an indicator.
B-33. Use a bore gage.

B-34. Use a height micrometer.
B-35. Use special micrometers.
B-36. Use electronic measuring devices.

UNIT C. Bench Work

C- 1. Practice proper safety and maintenance procedures on bench operations.
C- 2. Select cutting tools.
C- 3. Select noncutting tools.
C- 4. Use files.
C- 5. Tap a through hole.
C- 6. Tap a blind hole.
C- 7. Cut a thread-die.
C- 8. Cut a workpiece with a hacksaw.
C- 9. Drill a hole with a hand drill.
C-10. Ream a hole with a hand reamer.
C-11. Use chisels.
C-12. Use a hand grinder.
C-13. Use broaches.
C-14. Polish a workpiece with grit paper.
C-15. Remove a broken tap.
C-16. Select and install a heli-coil.
C-17. Select and use wrenches.
C-18. Select and use hammers.
C-19. Select and use screwdrivers.
C-20. Select and use pin punches.
C-21. Select and use transfer punches.
C-22. Select and use pliers.
C-23. Select and use hand stamps.
C-24. Select and use presses.

UNIT D. Layout

D- 1. Use calipers (ID, OD, and hermaphrodites).
D- 2. Lay out with a combination square.
D- 3. Lay out with a scriber, divider, and trammel.
D- 4. Use a surface plate.
D- 5. Use a surface gage.
D- 6. Use a veneer height gage.
D- 7. Use a sine bar.
D- 8. Use Jo blocks.
D- 9. Use lay out fluid.
D-10. Use V-blocks.
D-11. Use clamps.
D-12. Use an angle plate.
D-13. Use parallels.
D-14. Use punches.
D-15. Use transfer method tools.
D-16. Use a layout hammer.

D-17. Use a sine plate.
D-18. Use a sine vise.
D-19. Use a planner gage.
D-20. Use angle-gage blocks.
D-21. Use indicators.
D-22. Use a universal bevel protractor.
D-23. Use a machinist's square.

UNIT E. Power Saws

E- 1. Practice proper safety procedures on power saws.
E- 2. Perform maintenance on the power saws.
E- 3. Select types of power saws.
E- 4. Operate the power saws in the proper manner.
E- 5. Weld a blade.
E- 6. Store a blade.
E- 7. Install a blade.
E- 8. Set blade speed and feeds.
E- 9. Mount and use attachment.
E-10. Cut a straight line.
E-11. Make an angular saw cut.
E-12. Make an internal saw cut.
E-13. Make a contour saw cut.

UNIT F. Abrasives

F- 1. Practice proper safety procedures on abrasive machines.
F- 2. Perform maintenance on the abrasive machines.
F- 3. Select abrasive machines.
F- 4. Operate the abrasive machines.
F- 5. Mount a grinding wheel.
F- 6. Grind machine cutting tools.
F- 7. Grind and repair hand tools.
F- 8. Buff and polish.
F- 9. Grind flat and parallel.
F-10. Grind an angle.
F-11. Grind to a shoulder.
F-12. Grind a workpiece square.
F-13. Grind a diamond (ID and OD).
F-14. Grind a taper and diamond.

UNIT G. Superabrasives

G- 1. Select a machine.
G- 2. Select tooling.
G- 3. Mount tooling and work.
G- 4. Adjust tooling.
G- 5. Determine and set cutting speeds.
G- 6. Select and apply coolant.

G- 7. Cut a predetermined quantity of stock.
G- 8. Inspect the surface finish and part size, and resume cutting.
G- 9. Inspect the finished part.
G-10. Inspect the tooling for excessive wear.
G-11. Complete shutdown procedures.

UNIT H. Shapers

H- 1. Practice proper safety procedures on the shaper and planer.
H- 2. Perform maintenance on the shaper and planer.
H- 3. Select types of shapers and planers.
H- 4. Operate the shaper and planer.
H- 5. Mount a workpiece in a vise.
H- 6. Mount a workpiece on a an angle plate.
H- 7. Mount work directly to the table.
H- 8. Mount on the tool holder.
H- 9. Use a hold-down to hold a workpiece.
H-10. Set the proper feed and speed.
H-11. Set the stroke length and position.
H-12. Cut a workpiece vertically and horizontally.
H-13. Cut an angle on a workpiece.

UNIT I. Lathes

I- 1. Practice proper safety procedures on the lathe.
I- 2. Perform maintenance on the lathe.
I- 3. Select types of lathes.
I- 4. Operate the lathe.
I- 5. Set up and mount tool holders.
I- 6. Mount 3-jaw and 4-jaw chucks.
I- 7. Mount a workpiece between centers.
I- 8. Mount a workpiece on a face plate.
I- 9. Install and mount a workpiece in collects.
I-10. Turn the OD on a workpiece.
I-11. Step-turn a workpiece.
I-12. Mount and machine on a mandrel.
I-13. Cut a taper - offset method.
I-14. Cut a taper (ID) - compound method.
I-15. Cut a taper (OD) - compound method.
I-16. Cut a taper (ID) - taper attachment.
I-17. Cut a taper (OD) - taper attachment.
I-18. Face a workpiece.
I-19. Knurl a workpiece.
I-20. Center drill, drill, and ream a hole.
I-21. Bore a hole.
I-22. Use cutoff and parting tools.
I-23. Perform ID necking and grooving.
I-24. Perform OD necking and grooving.

I-25. Use forming tools.
I-26. Cut a V-thread, ID.
I-27. Cut a V-thread, OD.
I-28. Cut a left hand V thread.
I-29. Cut a square thread, ID.
I-30. Cut a square thread, OD.
I-31. Cut an Acme thread, ID.
I-32. Cut an Acme thread, OD.
I-33. Use the steady rest.
I-34. Use the follower rest.
I-35. Tap a workpiece.
I-36. Bar turn a workpiece.
I-37. Face groove a workpiece.
I-38. True a workpiece in a four-jaw chuck.
I-39. Align centers.
I-40. Counterbore.
I-41. Countersink.
I-42. Chamfer.
I-43. File and polish a workpiece.
I-44. Cut a double-head screw.
I-45. Use miscellaneous stops.

UNIT J. Drill Presses

J- 1. Practice proper safety procedures on the drilling machines.
J- 2. Perform maintenance on the drilling machines.
J- 3. Select types of drilling machines.
J- 4. Operate the drilling machines.
J- 5. Change feed and speeds.
J- 6. Change chuck and sleeve.
J- 7. Mount fixtures.
J- 8. Set up coolants.
J- 9. Center drill and straight drill.
J-10. Ream.
J-11. Counterbore.
J-12. Countersink.
J-13. Spot face.
J-14. Angle drill.
J-15. Spade drill.
J-16. Hand tap.
J-17. Power tap.
J-18. Use the boring head.
J-19. Deburr and polish.
J-20. Horn and lap.

UNIT K. Mills

K- 1. Practice proper safety procedures on the milling machines.
K- 2. Perform maintenance on the milling machines.

K- 3. Select types of milling machines.
K- 4. Operate milling machines.
K- 5. Mount tool holders and tools.
K- 6. Set speed and feeds.
K- 7. Use coolants.
K- 8. Perform climb and conventional milling.
K- 9. Mount and indicate the vise.
K-10. Indicate the head.
K-11. Use the index head.
K-12. Use the edge finder and wiggler.
K-13. Use a rotary table.
K-14. Use an angle plate.
K-15. Use a sine plate.
K-16. Use power feed accessories.
K-17. Straight mill.
K-18. Angular mill.
K-19. Coaxial indicating.
K-20. Coordinate drill and mill.
K-21. Bore.
K-22. Plain mill.
K-23. Gang mill.
K-24. Straddle mill.
K-25. Form mill.
K-26. Center drill and drill.
K-27. Ream a workpiece.
K-28. Tap a workpiece.
K-29. Cut gears.
K-30. Cut keyways.

UNIT L. CAM, CNC, and Robotics Equipment

L- 1. Operate control.
L- 2. Set axis zeros.
L- 3. Execute axis moves.
L- 4. Enter and execute turning.
L- 5. Enter and execute a shoulder cut.
L- 6. Enter and execute an angle and taper.
L- 7. Enter and execute thread chasing (ID and OD).
L- 8. Enter and execute a boring operation.
L- 9. Enter and execute tapping.
L-10. Enter and execute a facing operation.
L-11. Enter and execute a drilling operation.
L-12. Enter and execute convex and concave radii.
L-13. Enter and execute a linear cut.
L-14. Enter and execute a circular cut.
L-15. Enter and execute a pocket cut.
L-16. Enter and execute a contour cut.
L-17. Operate a computer and apply CAM and robotics software and hardware.
L-18. Interface with machine tool, CNC, and storage devices.
L-19. Execute program(s).

UNIT M. Heat Treating and Metallurgy

M- 1. Spark-test a workpiece.
M- 2. Harden a workpiece - furnace.
M- 3. Quench and cool a workpiece.
M- 4. Temper a workpiece.
M- 5. Anneal a workpiece.
M- 6. Normalize a workpiece.
M- 7. Carbonize a workpiece.
M- 8. Flame-harden a workpiece.
M- 9. Test a workpiece for hardness.

MACHINE TRADES LAB - JUNIOR YEAR

ORGANIZATIONAL CHART - JUNIOR YEAR

INSTRUCTIONAL GROUPS	WEEKS	INSTRUCTIONAL GROUP TITLE	NEW COMPETENCIES	LAB STATUS
I	1	ORIENTATION, SHOP MANAGEMENT, and SAFETY	10	CLOSED
II	2	USING MEASURING TOOLS	25	CLOSED
III	2	BENCHWORK	24	CLOSED
IV	2	LAYOUT	9	CLOSED
V	1	USING POWER SAW	13	CLOSED
VI	3	WORKING WITH ABRASIVES	14	CLOSED
VII	2	USING SHAPERS	13	CLOSED
VIII	1	DEVELOPING AND REINFORCING COMPETENCIES	0	CLOSED
IX	9	USING LATHES	30	CLOSED
X	1	USING DRILL PRESSES	14	CLOSED
XI	8	USING MILLS	30	CLOSED
XII	3	OPERATING CAM/CNC/ROBOTICS EQUIPMENT (BASIC LEVEL)	19	CLOSED
XIII	1	DEVELOPING AND REINFORCING COMPETENCIES	0	CLOSED

ROTATION CHART, JUNIOR YEAR / FIRST NINE WEEKS PERIOD

FOUR GROUPS / FIVE STUDENTS PER GROUP -- NO ROTATION FIRST WEEK

WEEK	USING LATHES			USING MILLS AND DRILL PRESSES			BENCHWORK, LAYOUT, & USING POWER SAWS	
1	ORIENTATION, SHOP MANAGEMENT, SAFETY AND MEASURING TOOLS B1-5, B 15, B 23							
2	1		2		3		4	
3		1		2		3		4
4	4		1		2		3	
5		4		1		2		3
6	3		4		1		2	
7		3		4		1		2
8	2		3		4		1	
9		2		3		4		1
COMPETENCIES	I1-6, I10, I18, I20			K1-7, K9, J1-6, J8-9			C1-5, C7-9, C11, C14 C17-20, C22-23 D1-5, D9, D14, D16 E1-4, E6-8, E10	

EACH SQUARE DENOTES FIVE DAYS

ROTATION CHART, JUNIOR YEAR / SECOND NINE WEEK PERIOD

FIVE GROUPS / FOUR STUDENTS PER GROUP

WEEK	USING MILLS	USING MEASURING TOOLS & SHAPERS		LAYOUT, WORKING WITH ABRASIVES AND DRILL PRESSES		USING LATHES			DEVELOPING & REINFORCING COMPENT.
1	1		2		3		4		5
2	5	1		2		3		4	
3		5	1		2		3		4
4	4		5	1		2		3	
5		4		5	1		2		3
6	3		4		5	1		2	
7		3		4		5	1		2
8	2		3		4		5	1	
9		2		3		4		5	1
COMPETENCIES	K10 K12 K16–17 K26–28	B6–8 B10 B24–25 B31–32	H1–5 H8 H10–11	D–10 F1–4, F6–7 J12, J16, J19		I 7, I 11, I 19, I 38–39, I 41–43			

EACH SQUARE DENOTES FIVE DAYS

ROTATION CHART, JUNIOR YEAR / THIRD NINE WEEK PERIOD

FIVE GROUPS / FOUR STUDENTS PER GROUP

WEEK	MEASURING TOOLS AND DRILL PRESSES	USING LATHES		USING MILLS			BENCHWORK, WORKING WITH ABRASIVES AND USING SHAPER		
1	1		2		3		4		5
2	5	1		2		3		4	
3		5	1		2		3		4
4	4		5	1		2		3	
5		4		5	1		2		3
6	3		4		5	1		2	
7		3		4		5	1		2
8	2		3		4		5	1	
9		2		3		4		5	1
COMPETENCIES	B9 B12 B16-17 B20-22 J10	I 9, I 20, I 24, I 26-27, I 35, I 40		K14 K22 K30			C6, C10, C12, C15, C21 F5, F9 H6		

EACH SQUARE DENOTES FIVE DAYS

ROTATION CHART, JUNIOR YEAR / FOURTH NINE WEEK PERIOD

FIVE GROUPS / FOUR STUDENTS PER GROUP

WEEK	MEASURING TOOLS, BENCHWORK, POWER SAWS, & DRILL PRESSES	USING LATHES AND WORKING WITH ABRASIVES		USING MILLS, SHAPERS AND DRILL PRESSES		OPERATING (BASIC) CAM/CNC/ROBOTICS EQUIPMENT			DEVELOPING & REINFORCING COMPETENCIES
1	1		2		3		4		5
2	5	1		2		3		4	
3		5	1		2		3		4
4	4		5	1		2		3	
5		4		5	1		2		3
6	3		4		5	1		2	
7		3		4		5	1		2
8	2		3		4		5	1	
9		2		3		4		5	1
COMPETENCIES	B30 C16, C24 E5, E9 E11-13 J17, J20	F 10-12 I 21, I 23, I 25, I 33-34		H7, H9, H13 J17, J20 K11, K18, K25		L 1-3, L19			

EACH SQUARE DENOTES FIVE DAYS

LAB INSTRUCTIONAL GROUP I: ORIENTATION, SHOP MANAGEMENT, AND SAFETY

Time Allotted: 1 week

Lab Status: Closed

Number of New Competencies: 10

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate to the instructor knowledge of lab management routines, lab duties, and safety through written tests.

Competencies Demonstrated and Practiced in This Lab Instructional Group

A- 1 Take shop safety/safety test.

A- 2 Explain emergency safety procedures.

A- 3 Explain lab rules.

A- 4 Review grading procedure.

A- 5 Receive safety glasses.

A- 6 Explain tool crib duties and receive tool checks.

A- 7 Describe maintenance schedule for the lab.

A- 8 Describe cleanup duties for the lab.

A- 9 List general lab supervisor's duties.

A-10 List lab safety supervisor's duties.

Suggested Management Strategies

1. Present the material contained in this instructional in great detail through lectures and demonstrations.

2. Require each student to view demonstrations of proper safety procedures before operating any equipment in the machine trades program.

3. Include the competencies in this grouping on the rotation chart to ensure that each student has the chance to take part in the management area of the program.

4. Review each student on a regular basis, thus ensuring that each student demonstrates a complete understanding of safety, rules, procedures, and management roles in the lab.

Evaluation Strategies

1. Observe for safe practices in the lab.

2. Observe students practicing competencies.

3. Maintain a student progress chart.

4. Administer a daily lab quiz.

5. Administer a comprehensive lab safety test at the completion of the instructional group.

LAB INSTRUCTIONAL GROUP II: MEASURING TOOLS

Time Allotted: 2 weeks

Lab Status: Closed

Number of New Competencies: 25

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate competence in using measuring tools; this will be evidenced by meeting blueprint specifications.

Competencies Demonstrated and Practiced in This Lab Instructional Group

B- 1 Use steel rules.

B- 2 Use a tape measures.

B- 3 Use calipers (ID, OD and hermaphrodites).

B- 4 Use dividers.

B- 5 Use a combination square set.

B- 6 Use a pitch gage.

B- 7 Use a center gage.

B- 8 Use a drill point gage.

B- 9 Use a depth gage.

B-10 Use a tool gage.

B-12 Use a protractor and depth gage.

B-15 Use a surface gage.

B-16 Use a feeler gage.

B-17 Use a combination depth and angle gage.

B-20 Use a hole gage.

B-21 Use a telescoping gage.

B-22 Use an inside micrometers.

B-23 Use an outside micrometers.

B-24 Use vernier calipers.

B-25 Use a depth micrometer.

B-28 Use Jo blocks.

B-29 Use a sine bar.

B-30 Use a universal bevel protractor.

B-31 Use a dial caliper.

B-32 Use a dial indicator.

Suggested Management Strategies

1. Explain, stress, and evaluate all lab and safety procedures. The students must perform competencies, demonstrating safe practices throughout the entire lab period.

2. Provide all tools, equipment, and supplies not in the student tool kit.

3. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit. Demonstrations should continue on a small-group or an individual basis as needed.

4. Provide adequate materials for lab projects.

5. Provide specialized equipment and tools needed for students to develop competency proficiency.

6. Analyze and update the rotation charts for exact application and determine if any modifications are necessary.

7. List each competency on a chart and check off by each student's progress.

8. Rotate students within a module when necessary to expose them to various manufacturers and styles of equipment available to the Machine Trades program.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students while they practice competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP III: BENCH WORK

Time Allotted: 2 weeks

Lab Status: Closed

Number of New Competencies: 24

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of benchwork operation through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

C- 1 Practice proper safety/maintenance on bench operations.

C- 2 Select cutting tools.

C- 3 Select noncutting tools.

C- 4 Use files.

C- 5 Tap a through hole.

C- 6 Tap a blind hole.

C- 7 Cut a thread-die.

C- 8 Cut a workpiece with a hacksaw.

C- 9 Drill a hole with a hand drill.

C-10 Ream a hole with a hand reamer.

C-11 Use chisels.

C-12 Use a hand grinder.

C-13 Use broaches.

C-14 Polish a workpiece with a grit paper.

C-15 Remove a broken tap.

C-16 Select and install a heli-coil.

C-17 Select and use wrenches.

C-18 Select and use hammers.

C-19 Select and use screwdrivers.

C-20 Select and use pin punches.

C-21 Select and use transfer punches.

C-22 Select and use pliers.

C-23 Select and use hand stamps.

C-24 Select and use presses.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or an individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials for lab projects.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this two-week period and to continue to practice thereafter.

SAFETY NOTE: Individual students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool in the machine trades program.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

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LAB INSTRUCTIONAL GROUP IV: LAY OUT

Time Allotted: 2 weeks

Lab Status: Closed

Number of New Competencies: 9

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of lay out work through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

D- 1 Use calipers (ID, OD and hermaphrodites).

D- 2 Lay out with a combination square.

D- 3 Lay out with a scriber, divider, and trammel.

D- 4 Use a surface plate.

D- 5 Use a surface gauge.

D- 9 Use lay out fluid.

D-10 Use V blocks.

D-14 Use punches.

D-16 Use a lay out hammer.

Suggested Management Strategies

1. Provide all equipment, tools, and materials not in the student tool kit.

2. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so students can begin performing the competencies in teams and in various areas, as equipment, tools, and materials allow.

3. Continue demonstrations in small groups or on an individual basis as needed.

4. Use a rotation schedule to ensure that all students have practice time on all competencies.

5. Analyze the rotation charts for their exact application and determine any modification necessary to meet local needs.

6. List each competency on a chart and check off by each student's progress.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP V: USING POWER SAWS

Time Allotted: 1 week

Lab Status: Closed

Number of New Competencies: 13

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of safe power saw usage through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

E- 1 Practice proper safety procedures on power saws.

E- 2 Perform maintenance on power saws.

E- 3 Select the types of power saws.

E- 4 Operate the power saws in the proper manner.

E- 5 Weld a blade.

E- 6 Store a blade.

E- 7 Install a blade.

E- 8 Set blade speed and feeds.

E- 9 Mount and use attachment.

E-10 Cut a straight line.

E-11 Make an angular saw cut.

E-12 Make an internal saw cut.

E-13 Make a contour saw cut.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or an individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials and storage for these materials.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this one-week period, and to continue to practice thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP VI: ABRASIVES

Time Allotted: 3 weeks

Lab Status: Closed

Number of New Competencies: 14

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of the safe use of abrasives through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

F- 1 Practice proper safety procedures on abrasive machine.

F- 2 Perform maintenance on abrasive machine.

F- 3 Select abrasive machine.

F- 4 Operate abrasive machine.

F- 5 Mount a grinding wheel.

F- 6 Grind machine cutting tools.

F- 7 Grind and repair hand tools.

F- 8 Buff and polish.

F- 9 Grind flat and parallel.

F-10 Grind an angle.

F-11 Grind to a shoulder cut.

F-12 Grind a workpiece square.

F-13 Grind a diameter (ID and OD).

F-14 Grind a taper and diameter.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials for lab projects.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this three-week period and to continue to practice thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP VII: SHAPERS

Time Allotted: 2 weeks

Lab Status: Closed

Number of New Competencies: 13

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of the Shaper operation through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

H- 1 Practice proper safety procedures on shaper and planer.

H- 2 Perform maintenance on shaper and planer.

H- 3 Select the types of shapers and planers.

H- 4 Operate the shaper and planer in the proper manner.

H- 5 Mount a workpiece in a vise.

H- 6 Mount a workpiece on an angle plate.

H- 7 Mount work directly to the table.

H- 8 Mount the tool holder.

H- 9 Use a hold-down to hold a workpiece.

H-10 Set the proper feed and speed.

H-11 Set the stroke length and position.

H-12 Cut a workpiece vertically and horizontally.

H-13 Cut an angle on a workpiece.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials and storage for lab projects.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this two-week period and to continue to practice thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP VIII: DEVELOPING AND REINFORCING COMPETENCIES

Time Allotted: 1 week

Lab Status: Closed

Number of New Competencies: 0

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will perform competencies that have been demonstrated and practiced in the previous instructional groups. All work must be performed according to blueprint specifications.

Competencies Demonstrated and Practiced in This Lab Instructional Group

All competencies from Instructional Groups I, II, III, IV, V, VI, and VII.

Suggested Management Strategies

1. Provide refresher demonstrations of competencies on a small-group or individual basis as needed.
2. Use this flexible time period to assign students additional practice on competencies and to prepare the lab for the next instructional group.
3. Follow the progress chart closely at this time to ensure that the students have performed the required competencies.
4. Assign additional practice time to students who have not achieved the demonstrated competencies up to this point. Likewise, students who have acquired skills in competencies may be assigned more advanced practice.

Evaluation Strategies

1. Observe for safe practices.
2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Evaluate completed skill assignments.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP IX: LATHES

Time Allotted: 9 weeks

Lab Status: Closed

Number of New Competencies: 30

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of safe lathe operation through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

I- 1 Practice proper safety procedures on the lathe.

I- 2 Perform maintenance on the lathe.

I- 3 Select the types of lathes.

I- 4 Operate the lathe in the proper manner.

I- 5 Set up and mount tool holders.

I- 6 Mount 3-jaw and 4-jaw chucks.

I- 7 Mount a workpiece between centers.

I- 8 Mount a workpiece on a face plate.

I- 9 Install and mount a workpiece in collets.

I-10 Turn the OD on a workpiece.

I-11 Step-turn a workpiece.

I-12 Mount and machine on a mantel.

I-13 Cut a taper-offset method.

I-14 Cut a taper (ID) - compound method.

I-15 Cut a taper (OD) - compound method.

I-16 Cut a taper (ID) - taper attachment.

I-17 Cut a taper (OD) - taper attachment.

I-18 Face a workpiece.

I-19 Knurl a workpiece.

I-20 Center drill, drill, and ream a hole.

I-21 Bore a hole.

I-22 Use cutoff and parting tools.

I-23 ID necking and grooving.

I-24 OD necking and grooving.

I-25 Use forming tools.

I-26 Cut a V thread, ID.

I-27 Cut a V thread, OD.

I-28 Cut a left-hand V thread.

I-29 Cut a square thread, ID.

I-30 Cut a square thread, OD.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials for lab projects.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this nine-week period and to continue to practice thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP X: DRILL PRESSES

Time Allotted: 1 week

Lab Status: Closed

Number of New Competencies: 14

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate the mastery of safe drilling machines through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

J- 1 Practice proper safety procedures on the drilling machines.

J- 2 Perform maintenance on the drilling machines.

J- 3 Select the types of drilling machines.

J- 4 Operate the drilling machines in the proper manner.

J- 5 Change feed and speeds.

J- 6 Change chuck and sleeve.

J- 8 Set up coolants.

J- 9 Center drill and straight drilling.

J-10 Ream.

J-12 Countersink.

J-16 Hand tap.

J-17 Power tap.

J-19 Deburr and polish.

J-20 Hone and lap.

Suggested Management Strategies

1. Provide all equipment, tools, and materials not in the student tool kit.

2. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so students can begin performing the competencies in teams and in various areas as equipment, tools, and materials allow.

3. Continue demonstrations on a small-group or individual basis as needed.

4. Use a rotation schedule to ensure that all students have practice time on all competencies.

5. Analyze the rotation charts for their exact application and determine any modification necessary to meet local needs.

6. List each competency on a progress chart for checkoff upon successful completion by each student.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XI: MILLS

Time Allotted: 8 weeks

Lab Status: Closed

Number of New Competencies: 22

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of safe mill operation through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

K- 1 Practice proper safety procedures on the milling machine.

K- 2 Perform maintenance on the milling machine.

K- 3 Select the types of milling machine.

K- 4 Operate the milling machine.

K- 5 Mount tool holders and tools.

K- 6 Set speed and feeds.

K- 7 Use coolants.

K- 8 Perform climb and conventional milling.

K- 9 Mount and indicate the vise.

K-10 Indicate the head.

K-11 Use the index head.

K-12 Use the edge finder and wiggler.

K-14 Use angle plate.

K-16 Use power feed accessories.

K-17 Straight mill.

K-18 Angular mill.

K-22 Plain mill.

K-25 Form mill.

K-26 Center drill and drill.

K-27 Ream a workpiece.

K-28 Tap a workpiece.

K-30 Cut keyways.

Suggested Management Strategies

1. Explain, stress, and evaluate all lab and safety procedures throughout the entire instructional grouping. The students must perform competencies, demonstrating safe practices throughout the program.

2. Provide all tools, equipment, and supplies not in the tool kit.

3. Select competencies and provide demonstrations for groups of five or six students at the beginning of this instructional grouping so that the students can begin performing the competencies in the work area.

4. Continue demonstrations on a small-group or individual basis as needed.

5. Provide the proper equipment and tooling for the students to develop competency proficiency.

6. List each competency on a chart and check off by each student's progress.

7. Rotate students when necessary to expose them to various manufacturers and styles of equipment.

8. Develop a rotation schedule to ensure that each student be given the appropriate time to complete the competencies required.

9. Develop an instructional system to help aid in the teaching of slower students in a way to maximize their success in the competencies.

SAFETY NOTE: Students must observe an instructor's

demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XII: CAM, CNC, AND ROBOTICS EQUIPMENT (BASIC)

Time Allotted: 8 weeks

Lab Status: Closed

Number of New Competencies: 19

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate basic level mastery of CAM, CNC, and Robotics Equipment through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

L- 1 Operate controls.

L- 2 Set axis zeros.

L- 3 Execute axis moves.

L- 4 Enter and execute turning cut.

L- 5 Enter and execute a shoulder cut.

L- 6 Enter and execute an angle and tape cut.

L- 7 Enter and execute thread chasing (OD and ID).

L- 8 Enter and execute a boring operation.

L- 9 Enter and execute tapping.

L-10 Enter and execute a facing operation.

L-11 Enter and execute a drilling operation.

L-12 Enter and execute a convex and concave radii.

L-13 Enter and execute a linear cut.

L-14 Enter and execute a circular cut.

L-15 Enter and execute a pocket cut.

L-16 Enter and execute a contour cut.

L-17 Operate a computer and apply CAM, CNC, and Robotics software and hardware.

L-18 Interface with machine tool, CNC, and storage device.

L-19 Execute programs.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or individual basis, as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials for lab projects.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this three-week period and to continue to practice thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XIII: DEVELOPING AND REINFORCING COMPETENCIES

Time Allotted: 1 week

Lab Status: Closed

Number of New Competencies: 0

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will perform competencies that have been demonstrated and practiced in the previous instructional groups. All work must be performed according to blueprint specifications.

Competencies Demonstrated and Practiced in This Lab Instructional Group

All competencies from Instructional Groups IX, X, XI, and XII.

Suggested Management Strategies

1. Give refresher demonstrations of competencies on a small-group or individual basis as needed.
2. Use this flexible time period to assign students additional practice on competencies and to prepare the lab for the next instructional group.
3. Follow the progress chart closely at this time to ensure that the students have performed the required competencies.
4. Assign additional practice time to students who have not achieved the demonstrated competencies up to this point. Likewise, students who have acquired skills in competencies may be assigned more advanced practice.

Evaluation Strategies

1. Observe for safe practices.
2. Maintain student progress charts.
3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

MACHINE TRADES LAB - SENIOR YEAR

ORGANIZATIONAL CHART - SENIOR YEAR

INSTRUCTIONAL GROUPS	WEEKS	INSTRUCTIONAL GROUP TITLE	NEW COMPETENCES	LAB STATUS
XIV	1	ORIENTATION, SHOP MANAGEMENT, and SAFETY	0	CLOSED
XV	2	USING MEASURING TOOLS and LAYOUT	25	SEMI-OPEN
XVI	2	WORKING WITH ABRASIVES (REVIEW)	0	SEMI-OPEN
XVII	2	WORKING WITH SUPER ABRASIVES	11	SEMI-OPEN
XVIII	1	HEAT TREATING AND METALLURGY	9	SEMI-OPEN
XIX	7	USING LATHES	15	SEMI-OPEN
XX	1	DEVELOPING AND REINFORCING COMPETENCIES	0	SEMI-OPEN
XXI	1	USING DRILL PRESSES	6	SEMI-OPEN
XXII	7	USING MILLS	8	SEMI-OPEN
XXIII	10	OPERATING CAM/CNC/ROBOTICS EQUIPMENT (INTERMEDIATE LEVEL)	0	SEMI-OPEN
XXIV	2	DEVELOPING AND REINFORCING COMPETENCIES	0	CLOSED

ROTATION CHART SENIOR YEAR / FIRST NINE - WEEK PERIOD

FOUR GROUPS / FIVE STUDENTS PER GROUP (NO ROTATION FIRST WEEK)

WEEK	USING MILLS		OPERATE CAM/CNC/ROBOTICS EQUIPMENT, USING DRILL PRESS			MEASURING TOOLS, BENCHWORK, AND LAYOUT	USING LATHES, WORKING WITH SUPERABRASIVES, AND HEAT TREATING AND METALLURGY	
1	ORIENTATION, SHOP MANAGEMENT, SAFETY							
2	1		2		3		4	
3		1		2		3		4
4	4		1		2		3	
5		4		1		2		3
6	3		4		1		2	
7		3		4		1		2
8	2		3		4		1	
9		2		3		4		1
COMPETENCIES	K-20, 24		J-11, 13, L-4,5,6,7			B-28,29, 37, C-13 D-6,7,8, 11,12,13, 15,21,23	G-1,5,6,11 M-1,9 I -22,45	

EACH SQUARE DENOTES FIVE DAYS

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ROTATION CHART SENIOR YEAR / SECOND NINE WEEK PERIOD

FIVE GROUPS / FOUR STUDENTS PER GROUP

WEEK	USING MILLS		OPERATE CAM/CNC/ROBOTICS EQUIPMENT (INTERMEDIATE)		WORKING WITH ABRASIVES		MEASURING TOOLS, SUPER-ABRASIVES, HEAT TREATING, LATHES, AND DRILLS		DEVELOPING & REINFORCING COMPETENCIES
1	1		2		3		4		5
2	5	1		2		3		4	
3		5	1		2		3		4
4	4		5	1		2		3	
5		4		5	1		2		3
6	3		4		5	1		2	
7		3		4		5	1		2
8	2		3		4		5	1	
9		2		3		4		5	1
COMPETENCIES	K-13, 15, 21		L-8, 9, 10, 11		F-8, 13, 14		B-11, 13, 14, 33 D-17, 18, 20 G-2,3,4 M-3, 7, 8 I-8, 13, J-7		

EACH SQUARE DENOTES FIVE DAYS

ROTATION CHART SENIOR YEAR / THIRD NINE WEEK PERIOD

FIVE GROUPS / FOUR STUDENTS PER GROUP

WEEK	OPERATING CAM/CNC/ROBOTICS EQUIPMENT			USING MILLS		USING LATHES		MEASURING TOOLS, DRILL PRESSES, SUPER-ABRASIVES AND HEAT TREATING	
1	1		2		3		4		5
2	5	1		2		3		4	
3		5	1		2		3		4
4	4		5	1		2		3	
5		4		5	1		2		3
6	3		4		5	1		2	
7		3		4		5	1		2
8	2		3		4		5	1	
9		2		3		4		5	1
COMPETENCES	L-12,13,14,15			K-19, 29		I-12,14,15,31,32		B-26,27 D-19,22 G-7 M-2,4,5,6 J-14,15	

EACH SQUARE DENOTES FIVE DAYS

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ROTATION CHART SENIOR YEAR / FOURTH NINE WEEK PERIOD

FIVE GROUPS / FOUR STUDENTS PER GROUP

WEEK	USING LATHES AND WORKING WITH SUPER-ABRASIVES			USING MILLS	USING DRILL PRESSES, MEASURING TOOLS, AND OPERATING CAM/CNC/ROBOTICS EQUIPMENT (INTERMEDIATE)			DEVELOPING & REINFORCING COMPETENCIES	
1	1		2		3		4		5
2	5	1		2		3		4	
3		5	1		2		3		4
4	4		5	1		2		3	
5		4		5	1		2		3
6	3		4		5	1		2	
7		3		4		5	1		2
8	2		3		4		5	1	
9		2		3		4		5	1
COMPETENCIES	G-8,9,10 I-16,17,28,29,30,36,37,44			K-23	B-35,36 J-18 L-16,17,18				

EACH SQUARE DENOTES FIVE DAYS

LAB INSTRUCTIONAL GROUP XIV: ORIENTATION, SHOP MANAGEMENT, AND SAFETY

Time Allotted: 1 week

Lab Status: Closed

Number of Review Competencies: 10

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate to the instructor(s), proper lab management, duties, and safety practices.

Competencies Demonstrated and Practiced in This Lab Instructional Group

A- 1 Take shop safety/safety test.

A- 2 Explain emergency safety procedures.

A- 3 Explain lab rules.

A- 4 Review grading procedure.

A- 5 Receive safety glasses.

A- 6 Explain tool crib duties and receive tool checks.

A- 7 Describe maintenance schedule for the lab.

A- 8 Describe clean-up duties for the lab.

A- 9 List general lab supervisor's duties.

A-10 List lab safety supervisor's duties.

Suggested Management Strategies

1. Review all shop management and safety procedures taught and practiced during the junior year.

2. Require each student to take a safety test and pass it with 100 percent accuracy. Demonstrate proper safety procedures on all equipment.

3. Include the competencies in this grouping on the rotation chart to ensure that each student has the chance to take part in the management area of the program.

4. Assess students individually to ensure that each student does demonstrate a complete understanding of safety, rules, procedures, and management roles in the lab.

Evaluation Strategies

1. Observe for safety being used in the lab.

2. Observe students practicing competencies.

3. Maintain a student progress chart.

4. Administer a daily lab quiz.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XV: MEASURING TOOLS AND LAY OUT

Time Allotted: 2 weeks

Lab Status: Semiopen

Number of New Competencies: 25

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate competence in using measuring tools; this will be evidenced by meeting blueprint specifications.

Competencies Demonstrated and Practiced in This Lab Instructional Group

B-11 Use an Acme thread gage.

B-13 Use a Go and No-go gage.

B-14 Use a snap gages.

B-18 Use a plug and ring gage.

B-19 Use a taper hole gage.

B-26 Use a cylindrical square.

B-27 Use thread wire.

B-33 Use a bore gage.

B-34 Use a height micrometer.

B-35 Use special micrometers.

B-36 Use electronic measuring devices.

D- 6 Use a vernier Height Gage.

D- 7 Use a sing bar.

D- 8 Use Jo blocks.

D-11 Use clamps.

D-12 Use an angle plate.

D-13 Use parallels.

D-15 Use transfer method tools.

D-17 Use a sing plate.

D-18 Use a sing vise.

D-19 Use a planer gage.

D-20 Use angle-gage blocks.

D-21 Use indicators.

D-22 Use a universal bevel protractor.

D-23 Use a machinist's square.

Suggested Management Strategies

1. Explain, stress, and evaluate lab and safety procedures throughout the entire teaching process. The students must perform competencies demonstrating safe practices throughout the entire lab period.

2. Provide all tools, equipment, and supplies not in the tool kit.

3. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit. Demonstrations should continue on a small-group or an individual basis as needed.

4. Provide adequate materials and storage for these materials.

5. Provide specialized equipment and tools needed for students to develop competency proficiency.

6. Analyze and update the rotation charts for their exact application and determine any modifications necessary to meet local needs.

7. List each competency on a chart and check off by each student's progress.

8. Rotate students when necessary within a module to expose them to various manufacturers and styles of equipment. A rotation schedule should be designed for appropriate modules.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students while practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XVI: ABRASIVES (REVIEW)

Time Allotted: 2 weeks

Lab Status: Semiopen

Number of Review Competencies: 14

Number of New Competencies: 0

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of the safe use of abrasives through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

F- 1. Practice proper safety procedures on abrasive machines.

F- 2. Perform maintenance on the abrasive machines.

F- 3. Select abrasive machines.

F- 4. Operate the abrasive machines.

F- 5. Mount a grinding wheel.

F- 6. Grind machine cutting tools.

F- 7. Grind and repair hand tools.

F- 8. Buff and polish.

F- 9. Grind flat and parallel.

F-10. Grind an angle.

F-11. Grind to a shoulder cut.

F-12. Grind a workpiece square.

F-13. Grind a diamond (ID and OD).

F-14. Grind a taper and diamond.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials for lab projects.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this two-week period and to practice regularly thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XVII: SUPERABRASIVES

Time Allotted: 2 weeks

Lab Status: Semiopen

Number of New Competencies: 11

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate knowledge about and skill in using superabrasive tools through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

G- 1. Select a machine.

G- 2. Select tooling.

G- 3. Mount tooling and work.

G- 4. Adjust tooling.

G- 5. Determine and set cutting speeds.

G- 6. Select and apply coolant.

G- 7. Cut a predetermined quantity of stock.

G- 8. Inspect the surface finish and part size, and resume cutting.

G- 9. Inspect the finished part size.

G-10. Inspect the tooling for excessive wear.

G-11. Complete shutdown procedure.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials and storage for lab projects.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this three-week period and to practice regularly thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Evaluate completed skill assignments.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XVIII: HEAT TREATING AND METALLURGY

Time Allotted: 1 week

Lab Status: Semiopen

Number of New Competencies: 9

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate knowledge about heat treating and metallurgy, and skill in heat treating processes; knowledge and skills will be measured by written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

M- 1. Spark-test a workpiece.

M- 2. Harden a workpiece.

M- 3. Quench and cool a workpiece.

M- 4. Temper a workpiece.

M- 5. Anneal a workpiece.

M- 6. Normalize a workpiece.

M- 7. Carbonize a workpiece.

M- 8. Flame-harden a workpiece.

M- 9. Test a workpiece for hardness.

Suggested Management Strategies

1. Explain, stress, and evaluate lab and safety procedures throughout the entire teaching process. The students must perform competencies demonstrating safe practices throughout the entire lab period.

2. Provide all tools, equipment, and supplies not in the student tool kit.

3. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit. Demonstrations should continue on a small-group or an individual basis as needed.

4. Provide adequate materials and storage for these materials.

5. Provide specialized equipment and tools needed for students to develop competency proficiency.

6. Analyze and update the rotation charts for exact application and determine any modifications necessary to meet local needs.

7. List each competency on a chart and check off by each student's progress.

8. Rotate students within a module to expose them to various manufacturers and styles of equipment. A rotation schedule should be designed for appropriate modules.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XIX: LATHES

Time Allotted: 7 weeks

Lab Status: Semiopen

Number of New Competencies: 15

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of safe lathe operation through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

I-31. Cut an Acme thread, ID.

I-32. Cut an Acme thread, OD.

I-33. Use the steady rest.

I-34. Use the follower rest.

I-35. Tap a workpiece.

I-36. Bar turn a workpiece.

I-37. Face groove a workpiece.

I-38. True a workpiece in a four-jaw chuck.

I-39. Align centers.

I-40. Counterbore.

I-41. Countersink.

I-42. Chamfer.

I-43. File and polish a workpiece.

I-44. Cut a doublehead screw.

I-45. Use miscellaneous stops.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials and storage for these materials.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this seven-week period and to practice regularly thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XX: DEVELOPING AND REINFORCING COMPETENCIES

Time Allotted: 1 week

Lab Status: Semiopen

Number of New Competencies: 0

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will perform competencies that have been demonstrated and practiced in the previous instructional groups. All work must be performed according to blueprint specifications.

Competencies Demonstrated and Practiced in This Lab Instructional Group

All competencies from Instructional Groups XIV, XV, XVI, XVII, XVIII, and XIX.

Suggested Management Strategies

1. Provide demonstrations on a small-group or individual basis as needed.
2. Assign students additional practice on competencies either on a remedial or advanced basis as needed.
3. Prepare the lab for the next instructional group. Follow the progress chart at this time to ensure that the students have performed the required competencies.
4. Provide further review and practice time for students who have not mastered the demonstrated competencies taught up to this point.

Evaluation Strategies

1. Observe for safe practices.
2. Maintain student progress charts.
3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XXI: DRILL PRESSES

Time Allotted: 1 week

Lab Status: Semiopen

Number of New Competencies: 6

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of safe operation on the drilling machines through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

J- 7 Mount fixtures.

J-11 Counterbore.

J-13 Spot face.

J-14 Angle drill.

J-15 Spade drill.

J-18 Use the boring head.

Suggested Management Strategies

1. Provide all equipment, tools, and materials not in the student tool kit purchased by the student.

2. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in teams and in various areas as equipment, tools, and materials allow.

3. Continue demonstrations on a small-group or individual basis, as needed.

4. Use a rotation schedule to ensure that all students have practice time on all competencies.

5. Analyze the rotation charts for their exact application and determine any modification necessary to meet local needs.

6. List each competency on a chart and check off by each student's progress.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XXII: MILLS

Time Allotted: 7 weeks

Lab Status: Semiclosed

Number of New Competencies: 8

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of safe mill operation through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

K-13 Use rotary table.

K-15 Use sine plate.

K-19 Demonstrate coaxial indicating.

K-20 Coordinate drill and mill.

K-21 Bore.

K-23 Gang mill.

K-24 Straddle mill.

K-29 Cut gears.

Suggested Management Strategies

1. Explain, stress, and evaluate all lab and safety procedures throughout the entire instructional group. The students must perform competencies, demonstrating safe practices throughout the remainder of the course.

2. Provide all tools, equipment, and supplies not in the tool kit purchased by the students to complete the competencies.

3. Select competencies and provide group demonstrations to groups of five or six students at the beginning of this instructional group so that the students can begin performing the competencies in the work area.

4. Continue demonstrations on a small-group or individual basis as needed.

5. Provide the proper equipment and tooling for the students to develop competency proficiency.

6. List each competency on a chart and check off by each student's progress.

7. Rotate students within a grouping if necessary to expose them to various manufacturers and styles of equipment available to the machine trades.

8. Use a rotation schedule to assure that each student be given enough time to complete the competencies required.

9. Develop an instructional system for special needs students that maximizes their opportunity for success in the competencies.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XXIII: CAM, CNC, AND ROBOTICS EQUIPMENT (INTERMEDIATE)

Time Allotted: 10 weeks

Lab Status: Semiopen

Number of New Competencies: 19

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will demonstrate mastery of CAM, CNC, and robotics equipment through written tests and lab performance.

Competencies Demonstrated and Practiced in This Lab Instructional Group

L- 1. Operate control.

L- 2. Set axis zeros.

L- 3. Execute axis moves.

L- 4. Enter and execute turning.

L- 5. Enter and execute a shoulder cut.

L- 6. Enter and execute an angle and taper.

L- 7. Enter and execute thread chasing (ID and OD).

L- 8. Enter and execute a boring operation.

L- 9. Enter and execute tapping.

L-10. Enter and execute a facing operation.

L-11. Enter and execute a drilling operation.

L-12. Enter and execute convex and concave radii.

L-13. Enter and execute a linear cut.

L-14. Enter and execute a circular cut.

L-15. Enter and execute a pocket cut.

L-16. Enter and execute a contour cut.

L-17. Operate a computer and apply CAM and robotics software and hardware.

L-18. Interface with machine tool, CNC, and storage devices.

L-19. Execute programs.

Suggested Management Strategies

1. Select key competencies and provide large-group demonstrations at the beginning of this instructional group so that students can begin performing the competencies in work areas as equipment and space permit.

2. Continue demonstrations on a small-group or an individual basis as needed.

3. Use a rotation schedule to ensure that each student has an opportunity to practice each competency.

4. Provide working blueprints to each student for each job assignment.

5. Provide adequate materials and storage for these materials.

6. Provide specialized equipment and tools for students to develop competency proficiency.

7. Require students to demonstrate all competencies for this instructional group within this 10-week period and to practice regularly thereafter.

SAFETY NOTE: Students must observe an instructor's demonstration, pass a test with 100 percent accuracy, and demonstrate proper safety procedures before operating any power tool.

Evaluation Strategies

1. Observe for safe practices.

2. Maintain student progress charts.

3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

LAB INSTRUCTIONAL GROUP XXIV: DEVELOPING AND REINFORCING COMPETENCIES

Time Allotted: 2 weeks

Lab Status: Closed

Number of New Competencies: 0

Instructional Group Objective: Given the necessary equipment, tools, materials, supplies, and instruction (including all safety precautions), the student will perform competencies that have been demonstrated and practiced in the previous instructional groups. All work must be performed according to blueprint specifications.

Competencies Demonstrated and Practiced in This Lab Instructional Group

All competencies from Instructional Groups XXI, XXII, and XXIII.

Suggested Management Strategies

1. Give refresher demonstrations of competencies on a small group or individual basis as needed.
2. Use this flexible time period to assign students additional practice on competencies and to prepare the lab for the next instructional group.
3. Follow the progress chart closely at this time to ensure that the students have performed the required competencies.
4. Assign additional practice time to students who have not achieved the demonstrated competencies up to this point. Likewise, students who have acquired skills in competencies may be assigned more advanced practice.

Evaluation Strategies

1. Observe for safe practices.
2. Maintain student progress charts.
3. Observe students practicing competencies.

4. Objectively assess students' completed projects according to prestated tolerances, time frames, and appearance standards.

5. Administer a comprehensive lab safety test at the completion of this instructional group.

APPENDIX

Progress charts are used to record the progress of each student through the individual assignments in each competency. A master form is included in this manual for the machine trades instructor to reproduce. On the sample progress charts blank spaces are provided for assignments or competency completions. It is important that the instructor log all individual assignments for each instructional group. It is not advisable to post progress charts in view of the general public, nor is it recommended that the charts be used for grades or any other type of evaluative information.

MACHINE TRADES PROGRESS CHART

INSTRUCTIONAL GROUP :